California Environmental Protection Agency

Air Resources Board

Gasoline Dispensing Facility (GDF)
Low Permeation Hose Upgrade Cost Report

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Introduction

In June of 2007, the California Air Resources Board (CARB) conducted a survey of manufacturers of gasoline dispensing facility (GDF) hose to determine the cost to upgrade current GDF hose in California to include low permeation hose technology. CARB staff requested projected cost increases for both balance and vacuum assist styles of vapor recovery hose and conventional (non-vapor recovery) hose. Staff's criteria, within the survey, for low permeation included that the hoses would be approximately 10 feet in length and would permeate at a rate of no more than 5 g/m^2/day when tested at a constant temperature of 40 ℃ with CE-10 test fuel. Subsequent hose testing with manufactures involved in the survey has shown prototypes capable of meeting a slightly less rigorous standard of 10 g/m^2/day when tested at a constant temperature of 38 ℃ with CE-10 test fuel.

From the survey, staff concluded that the cost to upgrade either a conventional hose or a vacuum assist style vapor recovery hose would be approximately $10. Staff found that a balance style vapor recovery hose upgrade would be approximately $29. Staff estimates that the cost of these upgrades would lead to price increases of current products for this style of hose of: 9% for vacuum assist hoses, 15% for balance hoses, and 26% for conventional hoses.

Background

It is part of CARB's mission to promote and protect the public health and welfare through the effective and efficient reduction of air pollutants. In carrying out this mission, CARB has sought to control hydrocarbon emissions at GDFs in California since 1975. Hydrocarbon emissions are reactive organic gases which can react in the atmosphere to form photochemical smog. Recently, CARB staff has identified GDF hoses as a sources of uncontrolled reactive organic gas emissions due to gasoline's ability to permeate through common GDF hose materials.

California GDFs, which are permitted by the local air pollution control districts, in most cases must use vapor recovery style hose. Vapor recovery hose is different from conventional fuel delivery hose in that it has two paths: one for fuel delivery and the other for vapor return. There are two different styles of vapor recovery hose: balance and vacuum assist. For permeation purposes, vacuum assist hoses are similar to standard fuel delivery hoses in that the liquid fuel is carried against the inside of the outer hose wall. Balance hoses are different, carrying vapor against the outer hose wall (Figure 1).

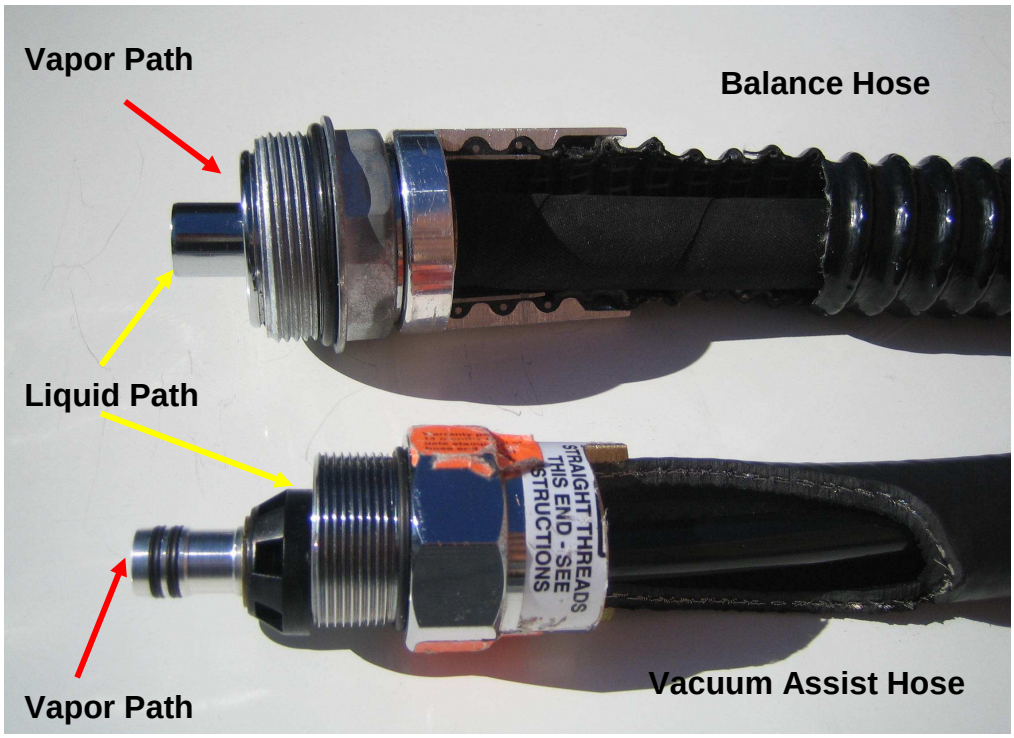

Figure 1 Cutaways of vapor recovery GDF hose showing vapor and liquid paths.

A common form of low permeation technology for fuel delivery hoses is the application of a barrier layer to the hose. The barrier layer is usually a material with a much lower permeation rate than the hose material which it is being added to. It is generally applied as an internal layer or the inner most layer of multi-layer hoses. It is generally a thinner layer than that of the hose it is being added to and it is generally more costly. CARB has certified over 40 such low permeation fuel delivery hoses for its small off road engine (SORE) program alone.[1]

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Current GDF Hose Prices

To better understand the significance of the estimates received in this survey, staff requested quotes from distributors of GDF hoses that are representative of those currently in use. The results of this investigation can be seen in Table 1.

Table 1: 2007 Hose Prices

Hose Type	Average Price	Median Price	Models Quoted	Total Quotes Obtained
Balance with Liquid Removal	$194.60	$196.54	2	5
Vacuum Assist	$110.64	$111.54	2	5
Conventional (Non-Vapor Recovery)	$37.81	$37.86	2	5

The Survey

As part of staff's effort to quantify the cost effectiveness of applying low permeation hose technology to GDF hoses, staff conducted the 2007 survey (Attachment 1) discussed in this report. The hose manufacturers that were surveyed by ARB staff include; FLEX-ING, Gates Corporation, Goodyear Tire & Rubber Company, HBD/Thermoid Inc., OPW Fueling Components, Parker Hannifin, and Vapor Systems Technologies Inc.

Staff has also been participating in testing of low permeation hose technology in conjunction with Underwriter's Laboratory (UL) and the above listed manufacturers. This testing has demonstrated several GDF hoses that can meet a permeation standard of 10 g/m^2/day at a constant temperature of 38 ℃ with CE-10 test fuel. Although this standard is slightly less rigorous than that mentioned in the survey (Attachment 1), it is a very large reduction from current GDF hoses, which for the same testing conditions have been shown to permeate at rates of over 300 g/m^2/day during the same UL testing. Given these testing results, staff is very confident that the numbers submitted in the survey reflect careful consideration by the companies involved in the survey.

On the outset of this survey, staff agreed with manufacturers to keep numbers reported by participants confidential by not tying specific numbers to individual companies. Staff agreed to this restriction in order to gain the sensitive marketing information necessary to conduct this analysis. Further, due to low responses for some categories, staff will only discuss the averages of the submittals each category so as not to give a competitor of companies that submitted cost estimates an unfair insight into those companies' business costs/projections.

Survey Response

All seven of the GDF hose manufacturers contacted for this survey submitted responses. However, two were rejected completely. One was rejected as the cost increases submitted by that respondent were an extreme outlier, being above the average of the other submittals by a factor of more than 10. The other was rejected as the company refused to supply actual dollar figures, submitting only percentages. As mentioned previously, for confidentiality reasons, staff will not discuss the specifics of the submitted numbers further.

Conventional (Non-Vapor Recovery) Hose Survey Results

The cost increase estimates for adding low permeation technology to conventional GDF hoses are displayed in Table 2. One participant (Participant A) felt that their

existing product would meet the permeation requirements given in the survey. This is evidenced by the zeros in the minimum column of Table 2. However, Participant A's existing product cost was more expensive than the average of the existing product costs of the other respondents. In order to correct for this, staff subtracted the average of the current manufacturer and end-user costs of current products of the other respondents from Participant A's current manufacturing and end-user costs. These differences were then applied as Participant A's cost increases. The averages* and medians* given in Table 2 reflect this correction.

Table 2: Low permeation cost increase for conventional hoses.

	Average*	Median*	Maximum	Minimum
Manufacturing Cost Increase	$5.52	$5.78	$6.15	$0.00
Cost Increase to Consumer	$9.89	$10.00	$17.72	$0.00

In applying the average cost increase to consumers of $9.89 given in Table 2 to the 2007 conventional hose price of $37.86 given in Table 1, the average cost increase as a percentage of current product costs is calculated to be 26 %.

Vacuum Assist Hose Survey Results

Although staff received less estimates for vacuum assist hose cost increases than for conventional hose, those that did respond noted to CARB staff that the technology applied to conventional hoses would be the same as that applied to vacuum assist hoses. Those respondents who submitted cost increases in both categories applied the same cost increases for vacuum assist and conventional hoses. Staff believes this is valid because the outer hose from which permeation would be controlled is essentially the same hose as a conventional hose with different fittings. Therefore, staff is applying the cost increase generated for conventional hoses of $9.89, as given in Table 2, as the vacuum assist hose cost increase to end-users. This leads to a cost increase of 9% from the original product price of $110.64, as given in Table 1.

Balance Hose Survey Results

Due to the low number of responses on this category, and the need for confidentiality, staff cannot provide as much information as provided in the previous categories. Because balance outer hoses are very dissimilar from that of vacuum assist hoses (see Figure 1) and conventional hoses, assumptions about

cost increases cannot be drawn directly from the conventional hose survey results as with vacuum assist hoses.

The average cost increase from the survey for upgrading balance hoses with low permeation technology was $29.07. This leads to a cost increase of 15% from the original product price of $194.60, as given in Table 1. The higher cost is likely due to the balance hose's exotic design of having a metal helix inside of the hose material running the length of the hose. This leads to a corrugated profile.

In July of 2007, staff requested a quote from a distributor of a common vapor recovery outer hose. The hose was a Flexaust product called Dayflex MG-U. One of its specific uses listed in the product literature is vapor recovery hose. Staff received a quote of $2.76 per linear foot assuming a quantity of 100 ft would be purchased. Thus, for a hose of approximately 10 feet in length, the original cost of the balance outer hose to an end-user would be $27.60. For the actual component of the balance hose that would be likely to undergo upgrading in order to control for permeation, staff found the cost increase would be 105%. Staff believes that this cost increase may be reasonable in light of the potential difficulty of applying a permeation barrier layer to the exotic design of the balance hose. Staff has not yet seen a prototype for low permeation balance hose.

Conclusion

Based upon the survey results and evidence collect through testing at Underwriter's Laboratory, CARB staff concludes that it is possible to upgrade GDF hoses with low permeation technology such that a hose 10 feet in length would permeate at a rate of no more than 10 g/m^2/day when tested at a constant temperature of 38 ℃ with CE-10 test fuel. Staff b elieves that the costs of meeting this standard would be approximately $10 for either a conventional hose or a vacuum assist style vapor recovery hose, and approximately $29 for a balance style vapor recovery hose. Staff estimates that the cost of these upgrade would lead to price increases of current products for these styles of hose of; 9% for vacuum assist hoses, 15% for balance hoses, and 26 % for conventional styles of hoses.

References

[1] “Small Off-Road Engine Component Executive Orders”, Revised June 8, 2008, California Air Resources Board, Accessed June 30, 2008, <http://www.arb.ca.gov/msprog/offroad/sore/sorecomponent/sorecomponent.htm>

Attachment 1

Linda S. Adams
Secretary for
Environmental Protection

Air Resources Board

Robert F. Sawyer, Ph.D., Chair
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Sacramento, California 95812 • www.arb.ca.gov

Arnold Schwarzenegger
Governor

June 8, 2007

To: Gasoline Dispensing Facility (GDF) Hose Manufacturers

The purpose of this letter is to request your help in collecting manufacturing cost information for low permeation GDF hoses. In March, 2005, the California Air Resources Board (ARB) conducted a cost effectiveness survey on low permeation GDF hoses, which specified a permeation limit of 2-5 g/m^2/day when tested with California commercial pump fuel at 28°C. ARB is now attempting to re-evaluate cost effectiveness estimates to reflect the current, more stringent, permeation standard that ARB is considering. Therefore, ARB is asking GDF hose manufacturers for an estimate on the manufacturing cost increase involved in producing GDF hose given the following parameters:

- The hose length is approximately 10 ft.
- The permeation standard is a maximum of 5 g/m^2/day.
- The test is performed at a constant temperature of 40°C.
- The test fuel is CE-10.

Please assist ARB in this endeavor by filling in the applicable sections of the enclosed survey.

Upon request, the source of the information provided to ARB regarding the enclosed survey can be kept confidential. Any confidential or proprietary information submitted will be handled in accordance with title 17 California Code of Regulations section 9100, which specifies the requirements for handling confidential information submitted to public agencies. The cost information provided will be used to help evaluate the cost effectiveness of setting permeation standards for GDF hoses.

If you have any questions concerning this request, please contact Jason McPhee at (916) 322-8116 or via email at jmcphee@arb.ca.gov, or contact me at (916) 327-1282 or via email at jwatson@arb.ca.gov.

Sincerely,

Jim Watson, Manager
Engineering Development and Testing Section
Monitoring and Laboratory Division

Enclosure

Attachment 1

Gasoline Dispensing Facility (GDF) Hose Upgrade Cost Survey

Purpose: The California Air Resources Board (ARB) is attempting to re-evaluate cost effectiveness estimates to reflect the current permeation standard that ARB is considering for GDF hose. Therefore, ARB is asking GDF hose manufacturers for an estimate on the manufacturing cost increase involved in producing GDF hose that will meet this permeation standard. Please assist ARB in this endeavor by filling in the applicable sections of this survey.

Date: _____

Company Name: _____

Please note that any reference to the term "permeation standard" in this survey refers to GDF hose that meets the general permeation hose parameters listed below.

General Permeation Hose Parameters:

1) The hose length (unit size) is approximately 10 ft.
2) The permeation standard is a maximum of 5 g/m2/day.
3) The test is performed at a constant temperature of 40℃.
4) The test fuel is CE-10.

Please fill in the table below. All costs are per unit, referring to a 10 ft. section of hose complete with end-fittings.

GDF Hose Type	Manufacturing Cost of Current Product	Manufacturing Cost Increase to Meet Permeation Standard	Final Manufacturing Cost to Meet Permeation Standard	End-User Cost of Current Product	End-User Cost Increase to Meet Permeation Standard	Final End-User Cost to Meet Permeation Standard
Balance	$	$	$	$	$	$
Vacuum Assist	$	$	$	$	$	$
Non-Vapor-Recovery	$	$	$	$	$	$

Comments and additional relevant GDF hose cost information : _____

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Confidentiality: Upon request, the source of the information provided to ARB regarding the above questions can be kept confidential. Any confidential or proprietary information submitted will be handled in accordance with title 17 California Code of Regulations section 9100, which specifies the requirements for handling confidential information submitted to public agencies.